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Original Research Article

Influence of Different Residue Based Composts and Biofertilizers on Microbial Activity and Yield of Pigeonpea (*Cajanus cajan* (L.) Millsp.)

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Keywords

Residue based composts, biofertilizers, dehydrogenase activity, phosphatase activity and pigeonpea yield

A B S T R A C T

A field experiment was conducted to study the effect of residue based composts and biofertilizers on dehydrogenase and phosphatase activity of soil at 120 DAS and yield of pigeonpea at Main Agricultural Research Station, Dharwad during *kharif* season of 2016-17 on medium black soils. The experiment was laid out in randomized complete block design with 9 treatments and 3 replications. The 9 treatments consists of T_1- T_6: sesame, wheat, pigeonpea, cotton and maize residue composts and FYM along with RDF and biofertilizers, respectively and T_7: FYM without biofertilizers along with RDF, T_8-RDF with biofertilizers and T_9-RDF alone. The results revealed that FYM with biofertilizers recorded significantly higher seed yield (2,158 kg/ha) of pigeonpea, dehydrogenase activity (76.40 µg TPF^{-1} g^{-1} soil day^{-1}) and phosphatase activity (207.60 µg p-nitro phenol g^{-1} hr^{-1}) as compared to biofertilizers along with RDF (1,387 kg/ha, 54.50 µg TPF^{-1} g^{-1} soil day^{-1} and 145.80 µg p-nitro phenol g^{-1} hr^{-1}, respectively) and RDF alone (1,283 kg/ha, 49.10 µg TPF^{-1} g^{-1} soil day^{-1} and 62.47 µg p-nitro phenol g^{-1} hr^{-1}, respectively).

Introduction

Pigeonpea (*Cajanus cajan* (L.) Millsp.) is one of the important pulse of Indian origine, plays a vital role in daily diet. It is known by the common names *viz.*, arhar, tur, redgram, congopea, no eye pea etc. and is the second most important pulse crop of India after chickpea. Its seeds are highly nutritious and rich in protein (21.7 %), carbohydrates, fibers and minerals. Among the major countries growing pigeonpea, India ranks first with about 75 per cent of the world area and 67 per cent of production. It occupies an area of about 3.5 million ha with a total production of 4.23 million tonnes, with an average productivity of 753 kg ha^{-1} (Anon., 2016).

Crop residues can be an important source of nutrients to subsequent crops. It has been estimated that India generates about 679 million tonnes of crop residues. Among different crops, cereals generate maximum residues (352 million tonnes), followed by fibers (66 million tonnes), oilseeds (29 million tonnes), pulses (13 million tonnes), sugarcane (12 million tonnes) and cotton

generates (53 million tonnes) (Anon., 2014). The pigeonpea yield is limited by number of factors such as agronomic, pathogenic, entomological, genetic factors and their interaction with environment. Among the different agronomic practices, inadequate and imbalanced nutrient application of nitrogen and phosphorus are considered more important for low and unstable yield in pigeonpea. Farmers are interested to cultivate crops under organic farming because of the escalating cost of inorganic fertilizers, decreased soil fertility, environmental and health concerns due to pesticide usage and higher premium prices for organic produce (Ramesh *et al.,* 2005). To enhance the productivity of this crop, use of balanced fertilization by application of organic manures, NPK along with biofertilizers is of great importance. Crop residues are good sources of plant nutrients and the composts prepared from this crop residues is an important way of recycling nutrients to the soil. Composts provide stable organic products that improves the physical, chemical and biological properties of soils, thereby enhancing soil quality and crop productivity (Dadhich *et al.,* 2012). Since livestock population is decreasing now a day's getting FYM is difficult, to address this problem use of on farm residue compost (prepared by using compost culture helps in faster decomposition) along with biofertilizers are an alternative nutrient sources for FYM.

Now-a-days compost culture (mixture of lingo-cellulololytic microbes' *viz., Trichoderma viridae, Phanerochaete chrysosporium, Pleurotus, Aspergillus sidowia*) is known for its efficiency in converting crop residues into good compost within 75-90 days. To enhance the productivity of pigeonpea, use of balanced fertilization by application of organic manures and chemical fertilizers along with biofertilizers *viz*., *Rhizobium*, PSB and Mycorrhiza have a stimulatory effect on increasing the nutrient availability and improve the yield parameters.

With this background, the present study was conducted to know the influence of different residue based composts and biofertilizers on microbial activity and yield of pigeonpea (*Cajanus cajan* (L.) Millsp.)

Materials and Methods

The experiment was conducted *kharif* season of 2016-17 at Main Agricultural Research Station, University of Agricultural Sciences Dharwad, Karnataka ($15^0$26' N latitude and $75^0$01' E longitude and at an altitude of 678 m above mean sea level). The soil type of experimental site was medium black clay soil. The initial soil was medium in organic carbon (0.52), low in nitrogen (250.6 kg/ha), medium in phosphorous (24.32 kg/ha) and high in potassium (398 kg/ha) with pH 7.20 and electrical conductivity (EC) 0.32 dS/m. The treatments comprised of T_1:Sesame residue compost at 6 t ha^{-1} + RDF + Biofertilizers, T_2:Wheat residue compost at 5.4 t/ha + RDF + Biofertilizers, T_3:Pigeonpea residue compost at 4 t/ha + RDF + Biofertilizers, T_4:Cotton residue compost at 7.1 t/ha + RDF + Biofertilizers, T_5:Maize residue compost at 6.4 t/ha + RDF + Biofertilizers, T_6:FYM at 6 t/ha + RDF + Biofertilizers, T_7:FYM at 6 t/ha + RDF + without Biofertilizers, T_8:RDF + Biofertilizers and T_9:RDF alone. The five crop residues (sesame, wheat, pigeonpea, cotton and maize) were composted in pits for 90 days using compost culture (Lata *et al.,* 2005) (*viz., Trichoderma viridae, Phanerochaete chrysosporium, Pleurotus, Aspergillus sidowia*). These composts were analysed for N, P and K contents (Table 1) and these were applied on N equivalent basis as that of FYM. The

experiment was laid out in Randomized Complete Block Design in with three replications.

Nitrogen was applied through DAP as starter dose (25:50) as per the treatments. Composts were applied before 15 days of sowing. Seeds were treated using *Rhizobium* and PSB @ 1,250 g/ha and mycorhyzae was applied to soil @ 20 kg/ha at the time of sowing. Two seeds per hill were dibbled 5 cm deep in furrows at a spacing of 120 cm x 20 cm and the variety used was TS-3(R). The crop was sown during second week of July.

The crop was harvested at its physiological maturity, grain and straw yields of rice were recorded at harvest. Composite soil sample was collected at 120 DAS and was analysed for dehydrogenase activity and phosphatase activity. Dehydrogenase activity was assayed in soil as per method by Casida *et al.,* (1964). The values were expressed as µh of triphenyl formazan (TPF)/g/day. Phosphatase activity was expressed as µg p-nitro phenol released /g soil/hr. (Evazi and Tabatabai 1979). The data of the experiment was analyzed statistically following procedure described by Gomez and Gomez (1984). The level of significance used in 'F' test was p=0.05.

Results and Discussion

Yield and yield attributes

Application of FYM @ 6 t/ha with biofertilizers (T_6) recorded significantly higher number of pods per plant (222.11), seed weight per plant (64.00 g), 100-seed weight (12.86 g), seed yield (2,158 kg/ha) and haulm yield (5,176 kg/ha) as compared to T_8 (144.78, 47.22 g, 11.07 g, 1,387 kg/ha and 4,313 kg/ha, respectively) and T_9 (142.44, 42.44 g, 9.88 g, 1,283 kg/ha and 4,183 kg/ha, respectively) (Table 2). Where, T_1, T_2, T_3, T_4, T_5 and T_7 were found on par with T_6. The increase in grain yield was mainly due to increase in the growth and yield parameters. And this might be due to the chemical fertilizers along with organic manures and biofertilizers which possibly increased the concentration of N, P and K ions in soil solution, ultimately influenced the formation of more number of root nodules, vigour, root growth and development, better N fixation and better development of plant parts leading to higher photosynthetic activity and translocation of photosynthates to the sink which in turn resulted in better development of yield attributes and finally higher seed yield. These results are in conformity with Jat and Ahlawat (2010) and Aher *et al.,* (2015),

Microbial activity

Organic matter is known to function as a source of energy for soil micro-flora which in turn brings about transformation of inorganic nutrients in a form that can readily be utilized by growing plants. Integrated farming practices such as application of composts along with inorganic fertilizers and biofertilizers improves biological health of soil which can be assessed by a number of microbial activity parameters in terms of dehydrogenase and phosphatase activity. In our study, microbial activity of soil samples showed a positive trend in the treatments in which combined application of organics, inorganics and biofertilizers were applied. Significantly highest dehydrogenase and phosphatase activity (Fig. 1) was recorded with T_6 and was found on par with T_1, T_2, T_3, T_4, T_5 and T_7. However significantly lower dehydrogenase and phosphatase activity in T8 and T9. Similar observations have been recorded by Dadhich *et al.,* 2012, Pane *et al.,* 2015 and Sunita and Lata (2012).

Table.1

Sl. No.	Particulars	% nutrient content		
		N	P	K
Composts nutrient content				
1	Sesame	0.45	0.17	0.7
2	Wheat	0.5	0.19	1.0
3	Pigeonpea	0.66	0.45	1.10
4	Cotton	0.38	0.20	0.43
5	Maize	0.42	0.22	0.44
6	FYM	0.45	0.20	0.48

Table.2 Yield and yield attributes of pigeonpea as influenced by different crop residue based composts, FYM and biofertilizers

Treatments	Number of pods per plant	Seed weight per plant (g)	100-seed weight (g)	Seed yield (kg/ha)	Stalk yield (kg/ha)
T_1	184.00	59.00	11.44	1,882	4,713
T_2	187.89	59.35	11.65	1,986	4,857
T_3	185.22	58.33	11.63	1,939	4,794
T_4	208.33	60.37	12.15	2,012	4,959
T_5	182.14	58.00	11.43	1,709	4,710
T_6	222.11	64.00	12.86	2,158	5,176
T_7	197.44	60.29	11.89	1,960	4,886
T_8	144.78	47.22	11.07	1,387	4,313
T_9	142.44	42.44	10.70	1,283	4,183
S. Em. ±	13.47	2.20	0.54	155	191
C. D. at 5 %	40.39	6.60	1.62	464	573

Fig.1 Dehydrogenase and phosphatase activity at 120 DAS of pigeonpea grown soil as influenced by different crop residue based composts, FYM and biofertilizers

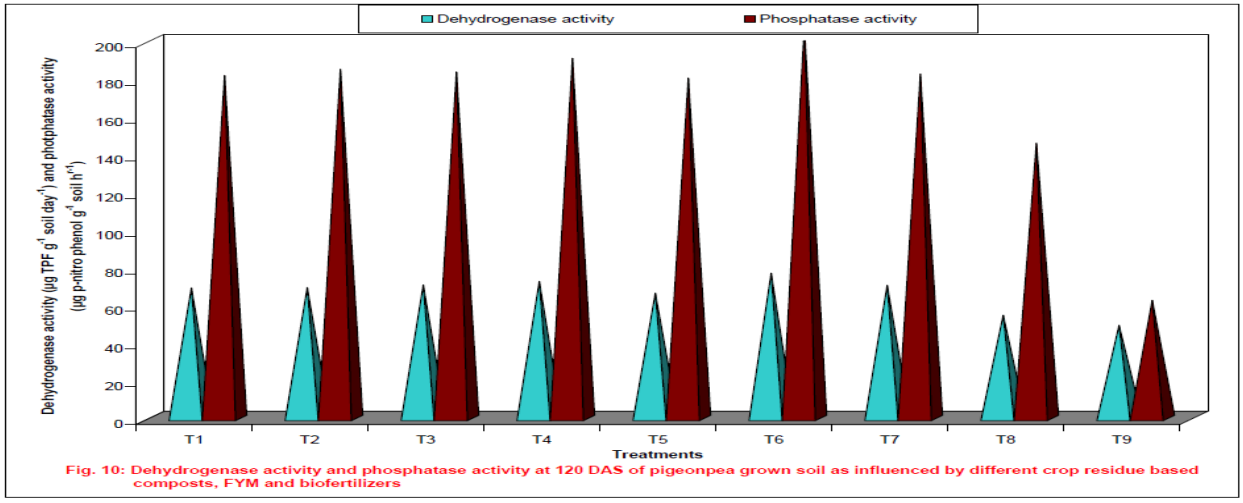

Fig. 10: Dehydrogenase activity and phosphatase activity at 120 DAS of pigeonpea grown soil as influenced by different crop residue based composts, FYM and biofertilizers

The explosion of Indian population demand of pulses. The high human population needs higher pulse production for satisfying the nutritive protein requirements. We are celebrating International pulse years 2016 and we will produce more amounts of pulses in upcoming centuries. Significant enhancement in the soil microbial activity in terms of dehydrogenase and phosphatase was recorded in integrated application with crop residue based composts as compared to chemical fertilizer application alone or along with biofertilizers. Grain yield and stover yield of pigeonpea were also significantly higher with these treatments. Based on the results obtained, it may be concluded that the residue based composts of sesame, wheat, pigeonpea, cotton and maize applied on N equivalent basis as that of FYM along with biofertilizers and RDF could be used as an alternative to FYM for higher productivity and profitability of pigeonpea.

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